US Army Corps of Engineers

DCAF Bulletin

Design Construction Analysis Feedback

No. 96-08 Issuing Office: CEMP-CE Issue Date: 28 JUN 96 Exp. Date: 30 DEC 98

CEMP-C

Subject: PLASTIC SHRINKAGE CRACKS

Applicability: GUIDANCE

1. Plastic shrinkage cracks commonly occur in the exposed surface of fresh concrete shortly after the concrete has been placed, while it is still plastic, and before it has attained any significant strength. They develop about the time the bleed water disappears from the surface. They are caused by the rapid evaporation of the water, resulting in an initial set of the concrete surface, which cannot accommodate the volume change (shrinkage) of the plastic concrete.

2. Even when the same design mix, method of mixing, placing, finishing and curing are used, cracks may occur on one day and not the next. This is due to changes in weather conditions, that cause a variation in evaporation rate. Variation in weather conditions occur on job sites from season to season and even from day to day. The three ambient conditions that have the greatest influence on evaporation rate are temperature, humidity and wind velocity. ACI 308-92, "Standard Practice for Curing Concrete" includes a monogram (copy enclosed) for determining evaporation rate. The fourth variable effecting evaporation is the actual temperature of the concrete. This is easily determined with a concrete thermometer. When the evaporation rate approaches 0.2 lb/sqft/hr (1.0 kg/sqm/hr) measures should be taken to prevent moisture loss.

3. Most procedures necessary for the prevention of plastic shrinkage cracks are just good construction practice that should be used at all times. Techniques that should be used to prevent this type of cracking are:

a. Dampen subgrade and forms.

b. Lower temperature of concrete in hot weather when necessary.

c. Reduce the time between placing and final finishing to a minimum.

d. Start curing procedures as soon as possible after final finishing. This is probably the most effective means of prevention.

e. Apply a fog spray if there is a significant delay between placing and finishing.

f. Provide sun shades to control temperature, and/or windbreaks to control wind velocity over the slab surface.

4. CEGS 03300, Paragraph 3.8.5 is very definitive concerning the extra effort required to prevent plastic shrinkage cracks. This subject should be discussed in detail at the Preparatory Phase Meeting. The QA Representative and the QC Manager should be thoroughly familiar with the material contained in ACI 302.1R, "Guide for Concrete Floor and Slab Construction", ACI 308-92, "Standard Practice for Curing Concrete" (especially the use of the enclosed nomogram), and ACI 305R-91, "Hot Weather Concreting". The QA Rep should verify that the contractor has the necessary material and equipment, and is adequately prepared to take the necessary measures to avoid plastic shrinkage cracking. Once plastic shrinkage cracking occurs, industry standards allow striking on each side of the crack with a float and retroweling. Corps Specs are much more stringent. The only remedy allowed is epoxy injection --- another reason why plastic shrinkage cracks must be avoided.

This DCAF was coordinated with Engineering Division (CEMP-ET).

CRSchroer

CHARLES R. SCHROER
Chief, Construction Division
Directorate of Military Programs

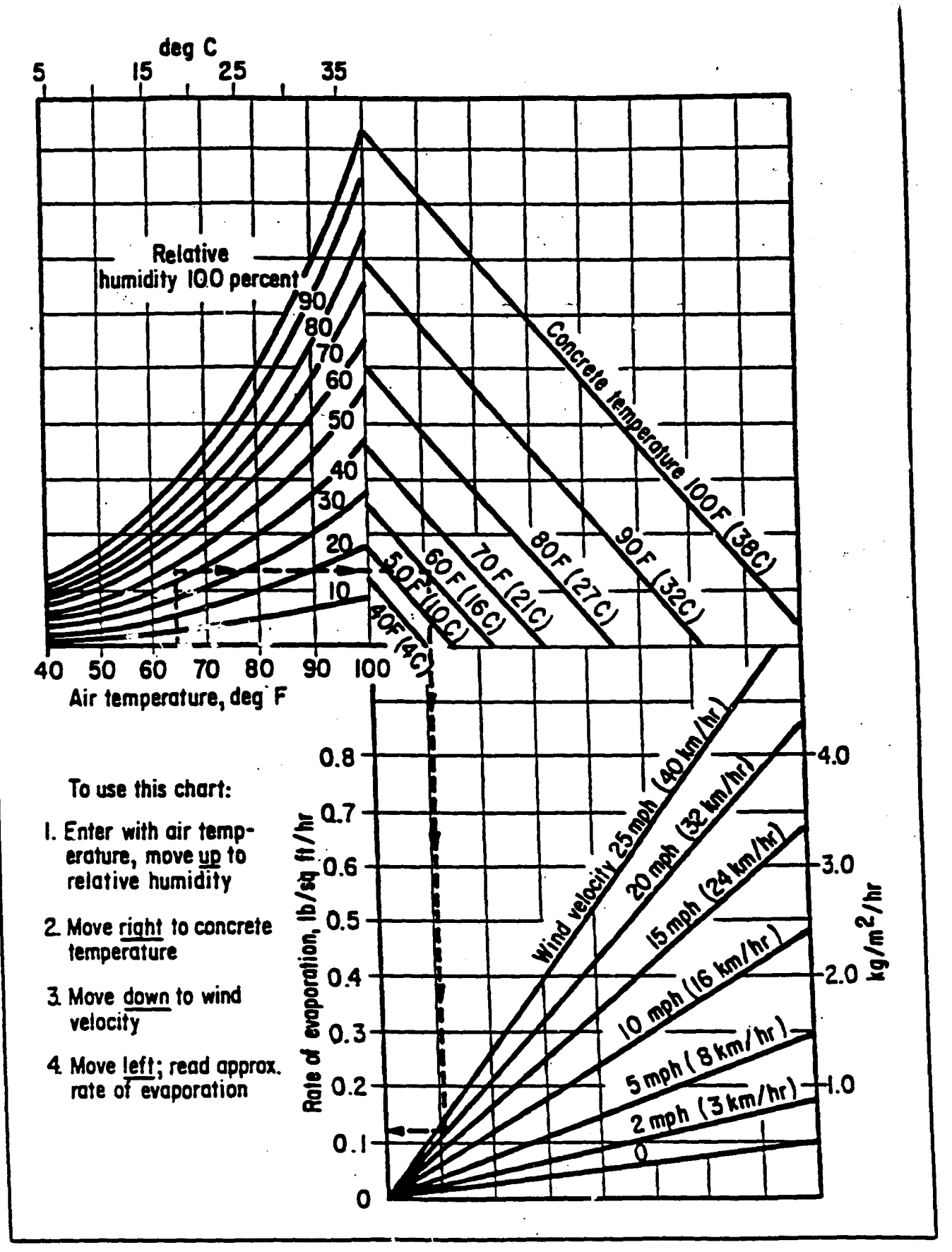

Fig. 1 — Effect of concrete and air temperatures, relative humidity, and wind velocity on the rate of evaporation of surface moisture from concrete. This chart provides a graphic method of estimating the loss of surface moisture for various weather conditions. To use the chart, follow the four steps outlined above. When the evaporation rate exceeds 0.2 lb/ft²/hr (1.0 kg/m²/hr), measures shall be taken to prevent excessive moisture loss from the surface of unhardened concrete; when the rate exceeds 0.1 lb/ft²/hr (0.5 kg/m²/hr) such measures may be needed. When excessive moisture loss is not prevented, plastic shrinkage cracking is likely to occur.